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Fig. 1.

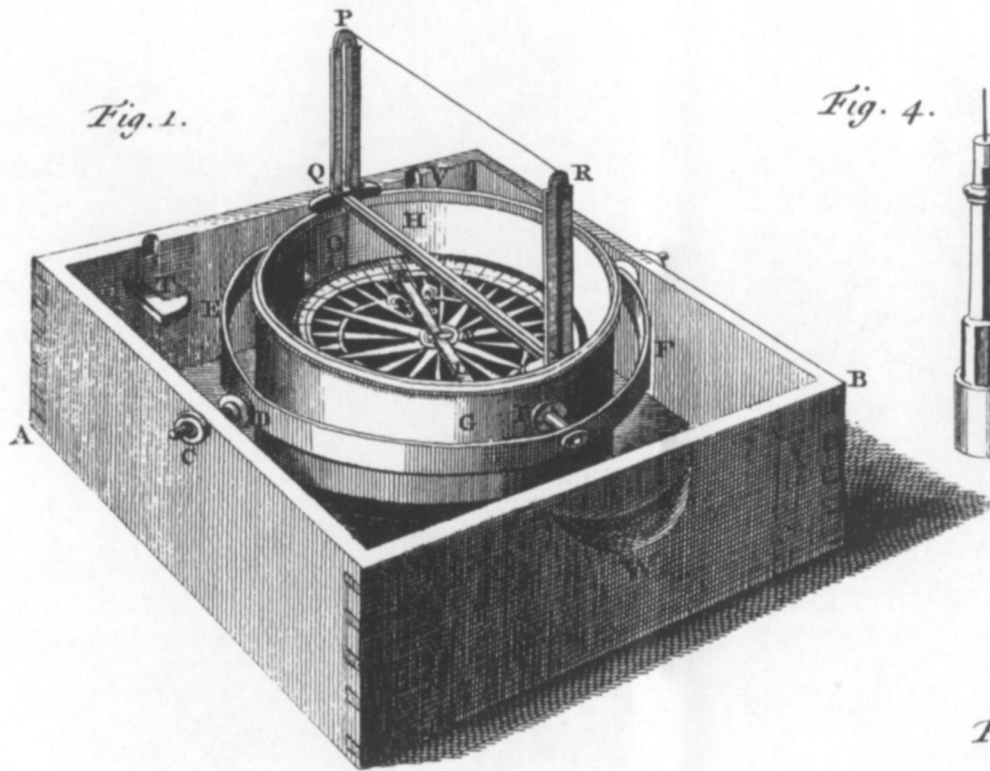


Fig. 4.



Fig. 3.

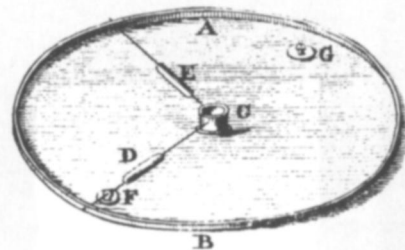
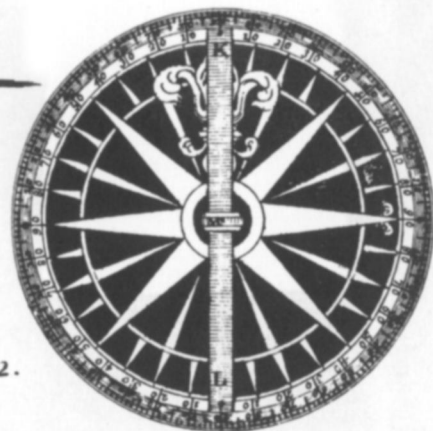


Fig. 2.



XIX. *An Account of some Improvements of the Mariners Compass, in order to render the Card and Needle, proposed by Doctor Knight, of general Use, by John Smeaton, Philosophical Instrument-maker.*

*Presented July 5, 1750.
here printed with Alter-
ations.*

THE Cover of the wooden Box being taken off, the Compass is in a Condition to be made use of in the Bittacle, when the Weather is moderate: But if the Sea runs high, as the inner Box is hung very free upon its Centres (the better to answer its other Purposes) it will be necessary to slacken the mill'd Nut, placed upon one of the Axes that supports the Ring, and to tighten the Nut on the Outside that corresponds to it. By this means the inner Box and Ring will be lifted up from the Edges, upon which they rest, when free; and the Friction will be increased, and that to any Degree necessary to prevent the too great Vibrations; which otherwise would be occasioned by the Motion of the Ship.

To make the Compass useful in taking the magnetic Azimuth, or Amplitude of the Sun and Stars, as also the Bearings of Head-lands, Ships, and other Objects at a Distance, the brass Edge, designed at first to support the Card, and throw the Weight thereof as near the Circumference as possible, is itself divided into Degrees and Halves; which may be easily estimated into smaller Parts, if necessary.

The

The Divisions are determined by means of a Cat-gut Line stretched perpendicularly with the Box as near the brass Edge as may be, that the Parallax arising from a different Position of the Observer may be as little as possible.

Underneath the Card are two small Weights, sliding on two Wires, placed at right Angles to each other; which, being moved nearer to, or farther from the Center, counterbalance the Dipping of the Card in different Latitudes, or restores the *Equilibrium* of it, where it happens by any other means to be got too much out of Level.

There is also added an *Index* at the Top of the inner Box, which may be put on and taken off at pleasure, and serves for all Altitudes of the Object. It consists of a Bar, equal in Length to the Diameter of the inner Box; each End being furnished with a perpendicular Stile, with a Slit parallel to the Sides thereof. One of the Slits is narrow, to which the Eye is applied, and the other is wider, with a small Catgut stretch'd up the Middle of it, and from thence continued horizontally from the Top of one Stile to the Top of the other: There is also a Line drawn along the upper Surface of the Bar. These four, *viz.* the narrow Slit, the horizontal Catgut Thread, the perpendicular one, and the Line on the Bar, are in the same Plane, which disposes itself perpendicular to the Horizon, when the inner Box is at rest, and hangs free. This *Index* does not move round, but is always placed on so as to answer the same Side of the Box.

When the Sun's Azimuth is desired, and his Rays are strong enough to cast a Shadow, turn about the wooden Box, till the Shadow of the horizontal

horizontal Thread; or (if the Sun be too low) till that of the perpendicular Thread in one Stile, or the Light through the Slit in the other, falls upon the Line on the *Index* Bar, or vibrates to an equal Distance on each Side of it, gently touching the Box, if it vibrate too far: Observe at the same time the Degree marked upon the brass Edge by the catgut Line. In counting the Degree for the Azimuth, or any other Angle that is reckon'd from the Meridian, make use of the outward Circle of Figures upon the brass Edge, and the Situation of the *Index* Bar, with regard to the Card and Needle, will always direct upon what Quarter of the Compass the Object is placed.

But if the Sun does not shine out sufficiently strong, place the Eye behind the narrow Slit in one of the Stiles, and turn the wooden Box about, till some Part of the horizontal or perpendicular Thread appears to intersect the Centre of the Sun, or vibrate to an equal Distance on each Side of it, using smoked Glass next the Eye, if the Sun's Light is too strong. In this Method another Observer will be generally necessary to note the Degree cut by the *Nonius*, at the same time the first gives notice that the Thread appears to split the Object.

From what has been said, the other Observations will be easily performed; only in case of the Sun's Amplitude, take care to number the Degree by the Help of the inner Circle of Figures on the Card, which are the Complements of the outer to 90, and consequently shew the Distance from East or West.

The Azimuth of the Stars may also be observed by Night; a proper Light serving equally for one Observer to see the Thread, and the other the Degree upon the Card.

It may not be amiss to remark farther, that, in case the inner Box should lose its *Equilibrium*, and consequently the *Index* be out of the Plane of a vertical Circle, an accurate Observation may still be made, provided the Sun's Shadow is distinct: For, by observing first with one End of the *Index* towards the Sun, and then the other, a Mean of the two Observations will be the Truth.

Explanation of the Figures.

Fig. 1. is a perspective View of the Compass, when in Order for Observation. The Point of View being the Centre of the Card, and the Distance of the Eye two Feet.

AB, is the wooden Box.

C and *D* are two mill'd Nuts; by means whereof the *Axes* of the inner Box and Ring are taken from their Edges, on which they move, and the Friction increased, when necessary.

EF is the Ring that supports the inner Box.

GH is the inner Box; and

I is one of its *Axes*, by which it is suspended on the Ring *EF*.

KL is the Magnet or Needle; and

M a small Brace of Ivory, that confines the Cap to its Place. See *Fig. 2.*

The Card is a single varnished Paper, reaching as far as the outer Circle of Figures, which is a Circle of

of thin Brass, the Edge whereof is turned down at right Angles to the Plane of the Card to make it more stiff.

O is a catgut Line drawn down the Inside of the Box ; for determining the Degree upon the brass Edge.

PQRS is the *Index* Bar, with its two Stiles and Catgut Threads; which being taken off from the Top of the Box, is placed in two Pieces, *T* and *V*, notched properly to receive it.

W is a Place cut out in the Wood, serving as an Handle.

Fig. 2. is the Card *in plano* with the Needle fixed upon it; being one Third of the Diameter of the real Card.

Fig. 3. is a perspective View of the Backside of the Card, where

AB represents the turning down of the brass Edge.

C is the under Part of the Ivory Cap.

D and *E* are the two sliding Weights to balance the Card ; and

F and *G*, two Screws that fix the brass Edge, &c. to the Needle.

Fig. 4. is the Pedestal that supports the Card, contained a sowing Needle, fixing in two small Grooves to receive it, by means of the Collet *C*, in the manner of a Port-Creyon. At *D* the Stem is filed into an Octagon, that it may be the more easily unscrew'd.